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Applicant : WESTINGHOUSE ELECTRIC CORPORATION

Title : RADIOACTIVE STRUCTURE STORAGE CASK AND MANUFACTURING METHOD THEREFOR

(57) [ABSTRACT] (Amended)

[OBJECT] To provide a lightweight, inexpensive nuclear energy plant storage-dedicated cask for fuel assemblies.

[CONFIGURATION] A storage cask 1 includes, as a main constituent element, a wall assembly 3 that defines a cask interior 5 complementary in shape to radioactive fuel assemblies 9 arranged in a rectangular column fashion. The wall assembly 3 consists of a plurality of flat metal plate wall members having side edges parallel to one another and an equal thickness. The adjacent side edges are coupled to each other by a welded portion that enters the thickness of the plate wall members only partially. The cask also includes a floor board 17 attached to the bottom of the wall assembly and a lid 19 detachably attached to the top of the wall assembly. A basket assembly 7 formed by assembling diaphragms 87 and 89 made of aluminum mixed with boric acid into a grid pattern while arranging the diaphragms parallel, equidistantly, is stored in the rectangular interior 5 of the cask. Each corner of the wall assembly is chamfered to minimize weight.

[Claim 1]A storage cask that stores radioactive structures and that has a polygonal cross section, comprising:

a wall assembly that defines a cask interior complementary in shape to

radioactive structure, having a diagonal cross section;

a floor board attached to a bottom of the wall assembly; and

a lid detachably attached to a top of the wall assembly, wherein

the wall assembly consists of a plurality of flat metal plate wall members comprising side edges coupled to each other in parallel and having an equal thickness.

[Claim 2]The storage cask according to claim 1, wherein

the radioactive structures are fuel assemblies arranged in a column fashion, and the wall assembly has a thickness sufficient to set a surface dosage to be less than 100 millirems per hour.

[0006]

It is possible to simply store spent fuel assemblies in the conventional cask at the site of a nuclear energy plant. However, since the thick iron inner container of the cask is cylindrical, efficiency in storing the spent fuel assemblies is lower than optimum efficiency in respect of the weight of shielding material used therefor. This low efficiency is caused by the fact that the interior of the inner container of the cask is rectangular (or at least diagonal) so as to be complementary in shape to the columnar rectangular fuel assemblies contained in the cask and that the outer wall of the cask is cylindrical. The maximum allowable surface dosage of the cask of this type is 200 millirems per hour on each part on the cask. Therefore, it is required to set the radius of the inner container sufficiently large so as not to exceed this maximum allowable surface dosage level on any part along the periphery of the cylindrical container having the thinnest wall (which parts are generally at the corners of the rectangular columns of the fuel assemblies). Because of the requirement for this minimum shielding force,

the wall of the cylindrical inner container has unavoidably a far larger thickness than the necessary thickness on the other parts around the container. If such cylindrical inner and outer containers are used in the transport/storage cask of a standard size, a large amount of excessive, unnecessary shielding material exists in the wall of this cask. The other causes for the low efficiency in respect of weight include the use of stainless steel which is relatively heavy for the basket assembly and the provision of a neutron flux trap between the adjacent fuel assemblies. Because of these two causes, the basket assembly used in the conventional art has a heavier weight than a limited weight necessary to store the fuel assemblies in the facility. In the conventional basket assembly, it is necessary to give necessary space for neutron flux traps, with the result that a maximum number of fuel assemblies cannot be contained in the cask. Therefore, to provide these flux traps, a large-scale basket is necessary, that disadvantageously increases the circumferential length (and, therefore, the weight) of the shielding wall around the basket. The other shortcoming of the use of the conventional cask to store the fuel assemblies in the facility is cost required to manufacture the cask. To manufacture a cylindrical inner container having a rectangular or diagonal interior and an integral wall, it is necessary to carry out expensive machining operation on a large scale. Further, if heavy and expensive stainless steels used for the basket assembly are welded to one another, the overall cost for manufacturing the cask is disadvantageously, considerably pushed up.

[0007]

[MEANS FOR SOLVING THE PROBLEMS]

Briefly, the present invention relates to a fuel assembly storage cask which is inexpensive, which has a minimum weight and which can solve or at least reduce the problems of a conventional transport/storage cask including high cost. A storage

cask according to the present invention is a cask that stores radioactive structures and that has a polygonal cross section, comprising: a wall assembly that defines a cask interior, complementary in shape to radioactive structure, having a diagonal cross section; a floor board attached to a bottom of the wall assembly; and a lid detachably attached to a top of the wall assembly, wherein the wall assembly consists of a plurality of flat metal plate wall members comprising side edges coupled to each other in parallel and having an equal thickness. The wall assembly has a thickness sufficient to set a surface dosage to be less than 100 millirems per hour. The adjacent side edges of plate wall members that form the wall assembly of the cask are coupled to each other by welded portions that enter the plate wall members by not more than 50%, preferably only about 10% of the entire thickness of the wall assembly. The wall assembly is formed by stacking a plurality of plate wall members. In a preferred embodiment, each side portion of the wall assembly is formed by only one plate wall member to facilitate manufacturing of the cask. The cross section of the wall assembly is typically square or rectangular so as to contain fuel assemblies closely packed into the grid-like basket assembly in a column fashion.

[0008]

To minimize the weight of the finally obtained cask, the adjacent side edges of the plate wall members that are coupled to each other have corners away from each other at a certain distance around the wall assembly. These corners are chamfered so that the shielding characteristics of the wall assembly become sufficiently equal over the surrounding of the assembly. Further, the edge portions in which the two different plate wall members are coupled to be adjacent each other include mutually fitted portions that avoid generating radioactive ray streaming channels in the boundary between the plate wall members.

[0009]

As explained above, the cask also includes a basket assembly that arranges the fuel assemblies stored in the interior of the cask wall assembly while separating them from one another in order. This basket assembly preferably consists of two types of diaphragms that are parallel and equidistant. The two types of diaphragms are assembled in a grid pattern to form a plurality of storage cells for the fuel assemblies. In a preferred embodiment, grooves located in parallel and equidistantly are provided around the inner wall of the wall assembly so as to slidably contain the outer edges of the diaphragms that form the basket assembly. Each diaphragm is preferably made of a light, inexpensive aluminum-boron alloy. This can prevent a critical nuclear reaction between the adjacent fuel assemblies from occurring.

[0010]

It is desirable to form the plate wall members by metal that can be easily welded and machined. The metal is preferably made of plate or casting low carbon steel. This is because the low carbon steel is inexpensive and can be obtained in a thick state.

[0012]

[Embodiment] Referring to Figs. 1 and 2 (in which the same reference numerals denote the same sections), a storage cask 1 according to the present invention includes, as a main constituent element, an inner wall assembly 3 made of low-carbon steel and including a rectangular interior 5 that stores a basket assembly 7. The basket assembly 7 stores a plurality of spent fuel assemblies 9 while arranging the assemblies 9 in a compact, rectangular fashion complementary to the rectangular interior 5 of the cask 1. The cask 1 also includes an outer wall assembly 11 that

includes a neutron absorption concrete or cement layer 13 having a high hydrogen content. This concrete layer 13 is located between the outer surface of the inner wall assembly 3 and the interiors of a plurality of circumferential fins 15 provided around the cask 1. Generally, the low carbon steel that is material for the inner wall assembly 3 measures γ rays emitted from the spent fuel assembly 9 on the surface of the cask and reduces the γ rays to allowable level. The concrete layer 13 having a high hydrogen content reduces neutron rays emitted from the fuel assembly 10 to allowable level. To facilitate the local movement and handling of the cask 1, upper and lower transport rugs 16 are directly attached to the inner wall assembly 3 by welding. A floor board 17 is welded around the bottoms of the inner wall assembly 3 and the outer wall assembly 11 so that the floor board 17 becomes the floor of the cask 1. A detachable lid 9 constitutes a watertight ceiling/roof for the cask 1. It is important to note that the corners 20 of the inner wall assembly 3 and the outer wall assembly 11 are chamfered as shown in the figure to thereby remove the unnecessary weight of the shielding material from the cask 1.

[0013] Fig. 3A shows the cross section of a preferred embodiment of the inner wall assembly 3. In this embodiment of the cask 1, each side portion of the inner wall assembly 3 consists of a simple solid plate wall member 23. The plate wall members 23 are thick sufficient to reduce γ rays emitted from the columnar spent fuel assemblies 9 stored in the rectangular interior 5 of the cask 1 to not more than 100 millirems per hour. The concentration of fissile uranium sealed into an advanced fuel assembly is high (e.g., the burn-up of 4% uranium up to initial enrichment of 45 GWD/T, and the reduction of the storage time of the advanced fuel assembly in the spent fuel pool of the present nuclear energy plant facility, e.g., 5-year cooling time). Therefore, the inventor of the present invention determines that each plate wall member 23 should

have a thickness comparable to about 12 inches so as to reduce γ rays on the surface of the cask 1 to a desired amount.

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(54)【発明の名称】 放射性構造体の貯蔵キャスク及びその製作方法

(57)【要約】 （修正有）

【目的】 核燃料集合体のための軽量で且つ安価な原子炉施設内貯蔵専用キャスクを提供する。

【構成】 貯蔵キャスク1は主構成要素として、矩形列状に配置された放射性の核燃料集合体9と形状が相補するキャスク内部5を画定する壁組立体3を有する。壁組立体3は、互いに平行な側縁部を備えた一様厚さの複数の平らな金属製板状壁部材から成り、側縁部は、板状壁部材の厚さを部分的にしか侵入しない溶接部によって互いに接合されている。キャスクは、壁組立体の底部に取り付けられた床板17及び壁組立体の頂部に着脱自在に装着できる蓋19を更に有する。ホウ酸を混ぜたアルミニウム製の仕切り板87、89を互いに平行で且つ等間隔を置いた関係で碁盤目状に組んで形成したバスケット組立体7が、キャスクの矩形内部5に収納される。重量を最少限に抑えるために、壁組立体の各コーナー部が面取りされる。

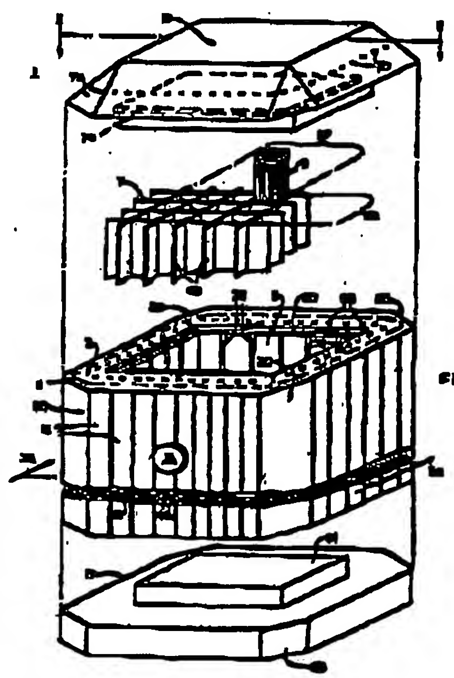

FIG.1

32 面取り部

46 伝熱リブ

【図1】

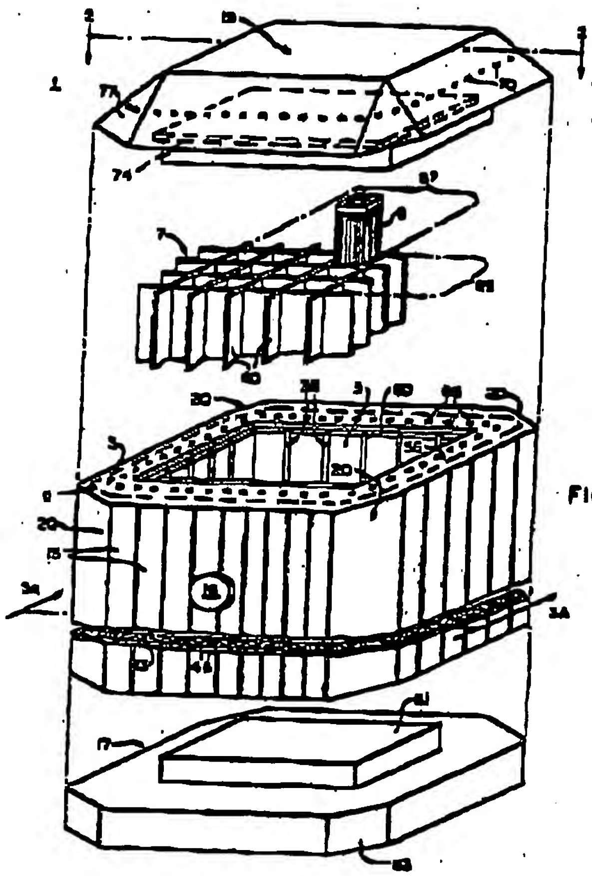

FIG.1.

【図2】

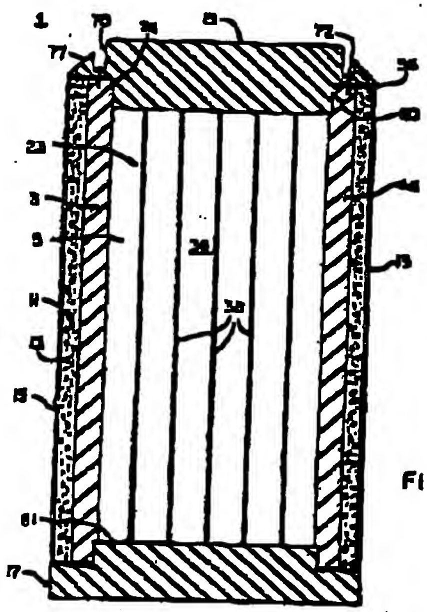

FIG.2.

【図6】

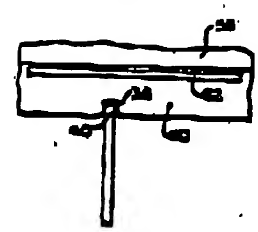

FIG.6.

【図4】

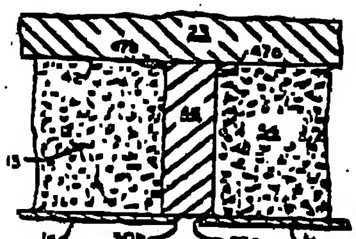

FIG.4.

【図5】

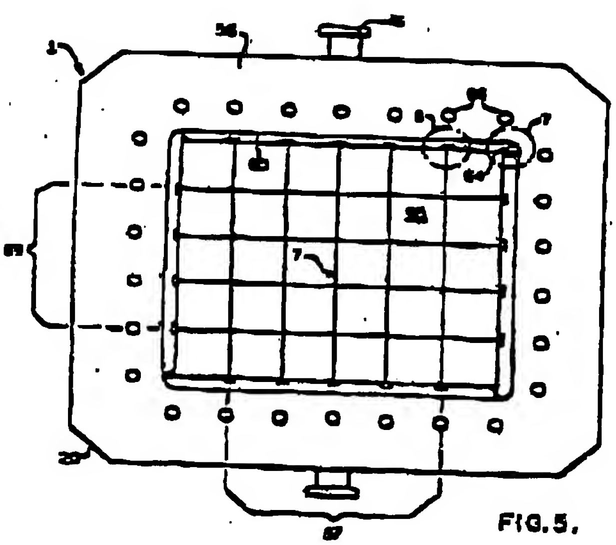

FIG.5.

【図7】

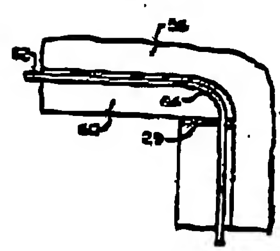

FIG.7.

【図3】

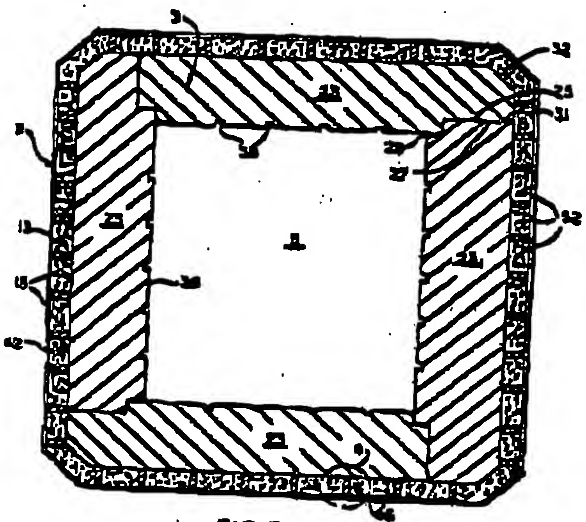

FIG.3A.

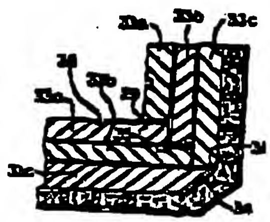

FIG.3B.

【図8】

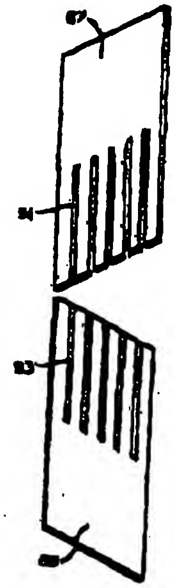

FIG.8.

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